Lead-210 and Beryllium-7 Simulations With GMI

Hongyu Liu
National Institute of Aerospace @ LaRC
David Considine
NASA Langley Research Center (LaRC)

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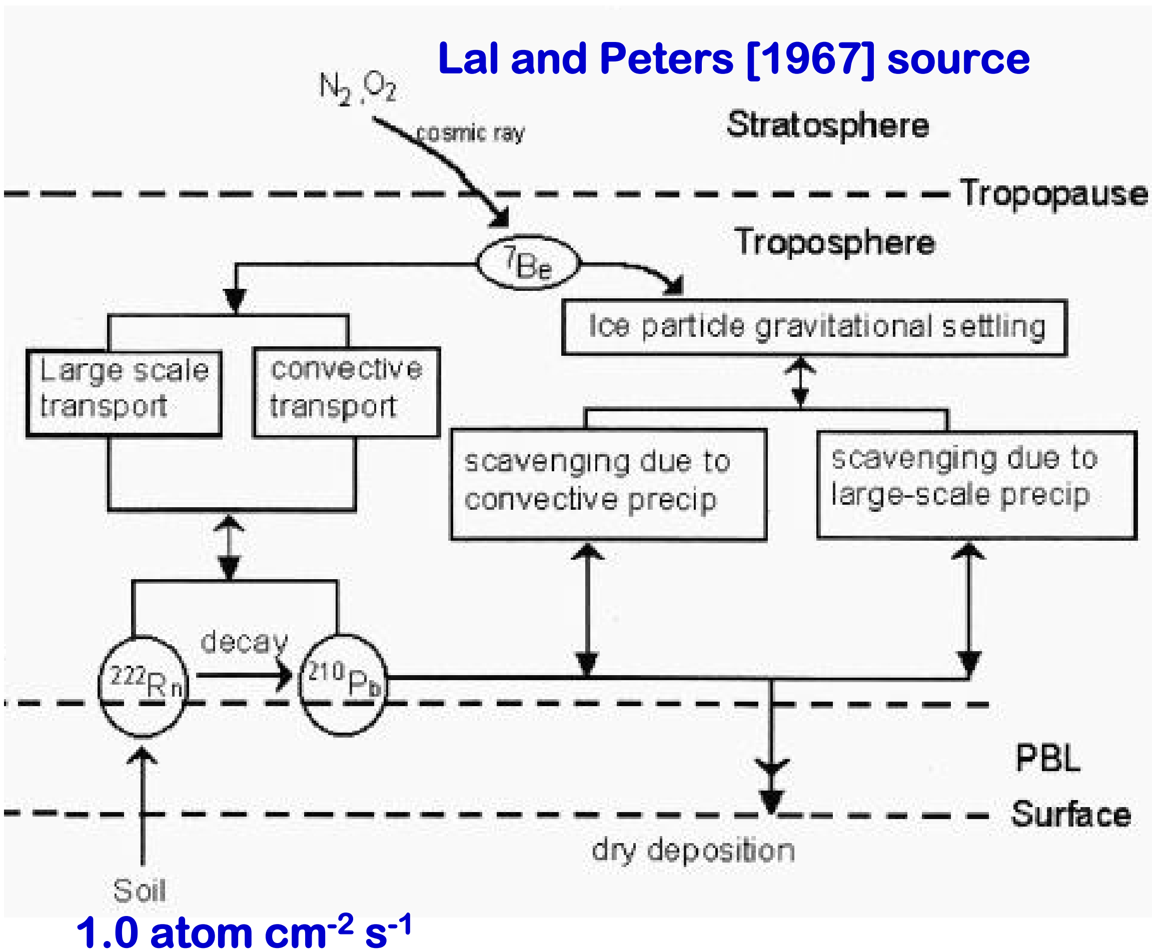
^{210}Pb-^{7}Be are a useful pair for testing wetdep processes in a global model because of their contrasting sources at low and high altitudes



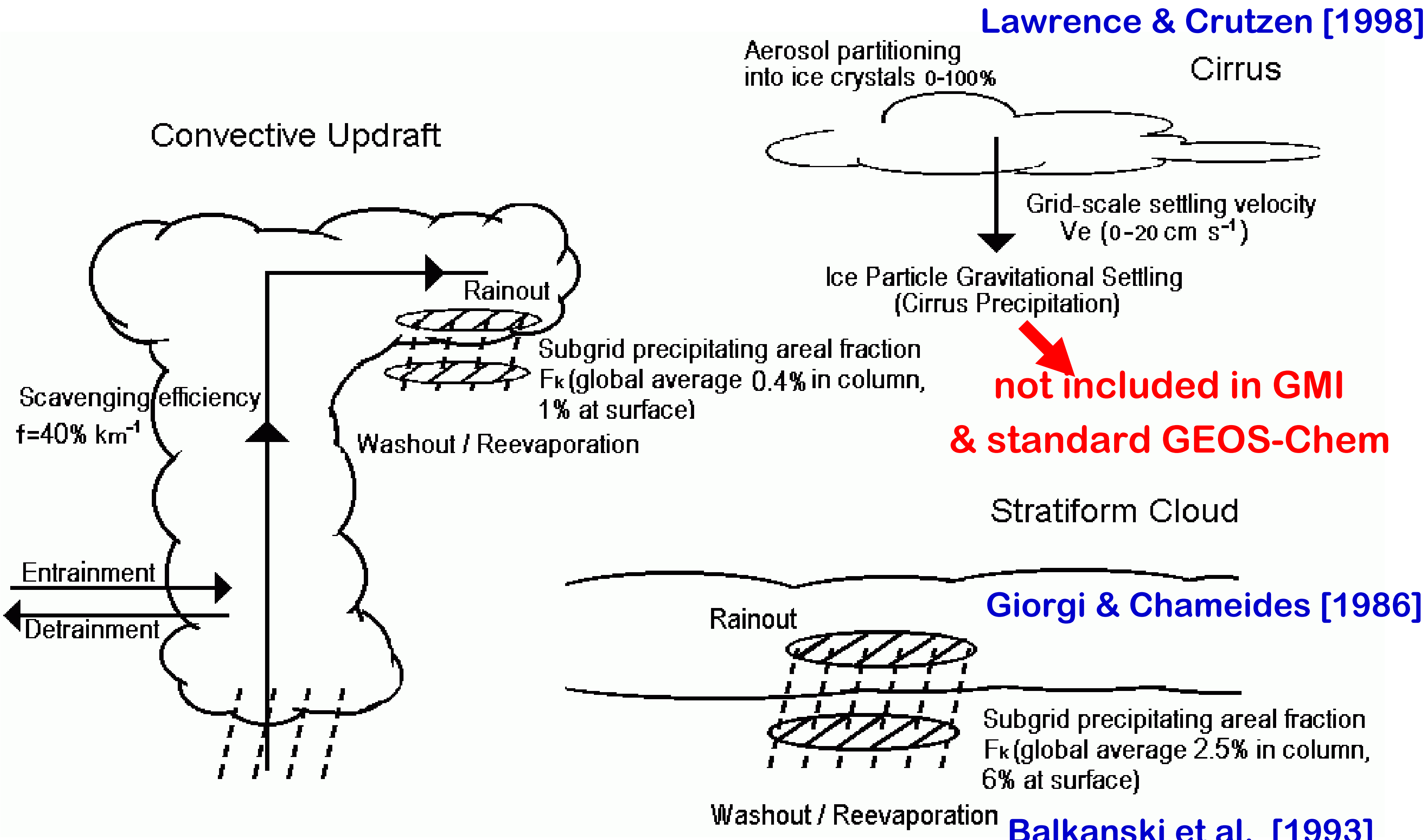
Objectives

- Continue to provide diagnostic support for GMI using atmospheric radionuclides

- Examine the constraints from both ^{210}Pb and ^{7}Be on wet deposition and transport in GMI and their uncertainties

- Use the GMI modeling framework to explore the usefulness of ^{7}Be in diagnosing cross-tropopause transport in global models

Harvard wet deposition scheme for GMI

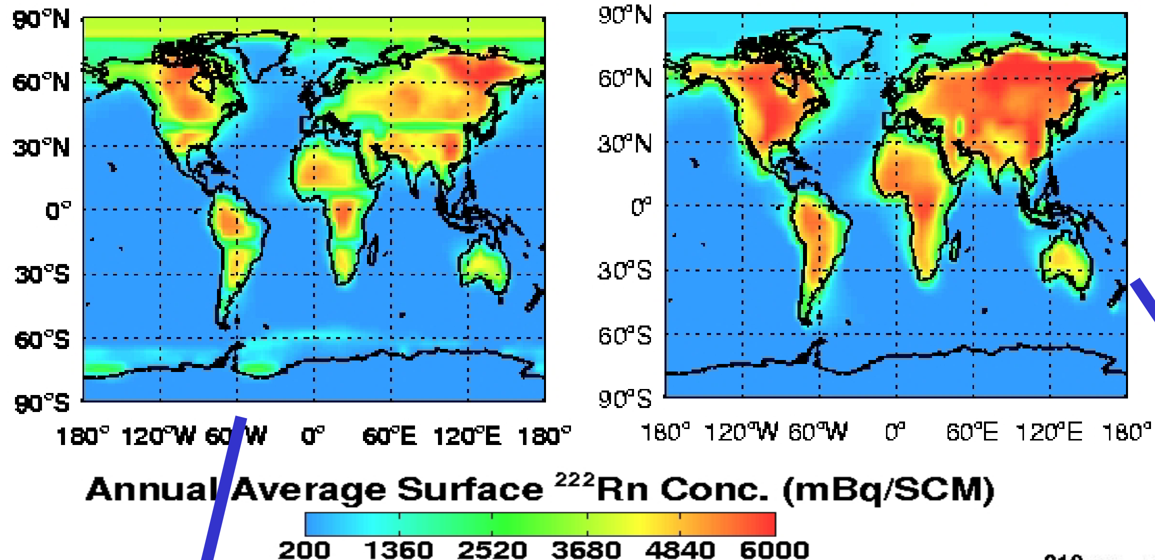


Liu et al. [2001]; Park et al. [2004]

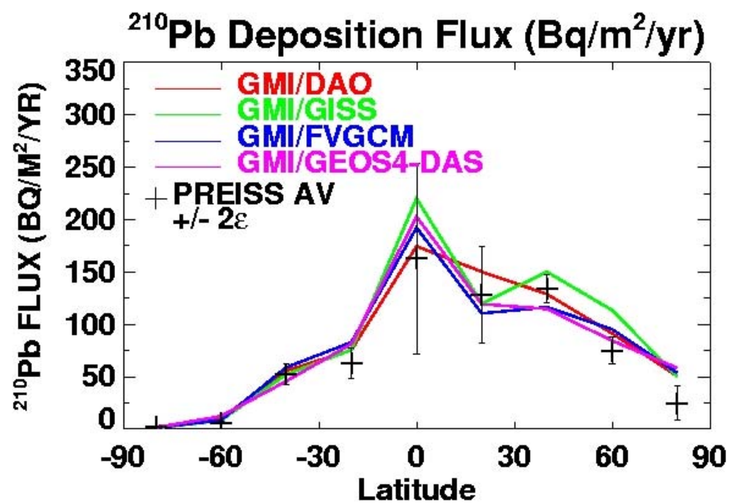
^{222}Rn simulations indicate a Land Water Index (LWI) problem in GEOS4-DAS (4ºx5º) met data

use LWI in GEOS4-DAS (incorrect LWI)

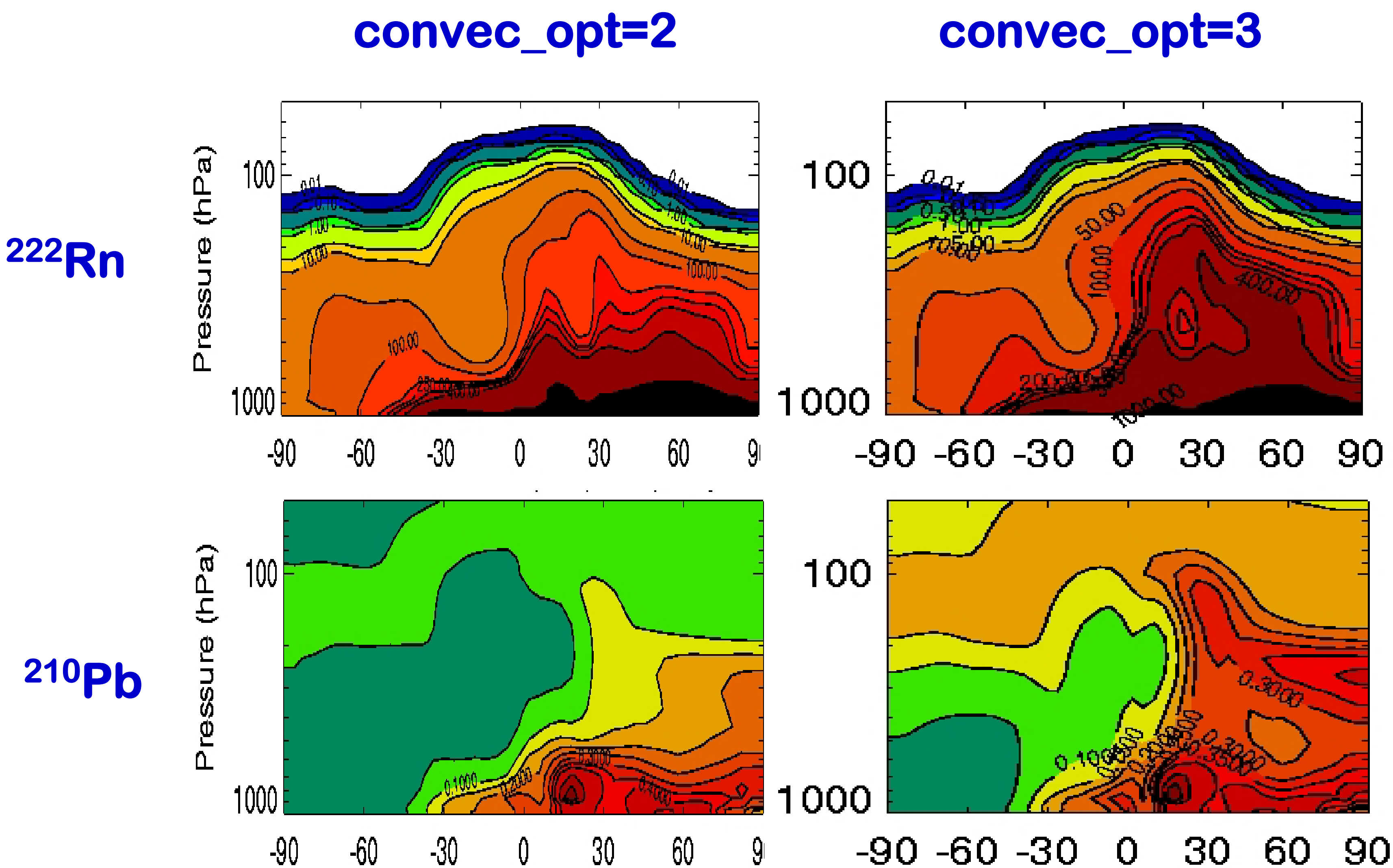
use hardwired LWI (correct LWI)



GEOS4-DAS ^{222}Rn emissions (and ^{210}Pb deposition fluxes) are too low with incorrect LWI



GMI/fvGCM July Average ^{222}Rn and ^{210}Pb (mBq/SCM): Effect of updated convective transport algorithm



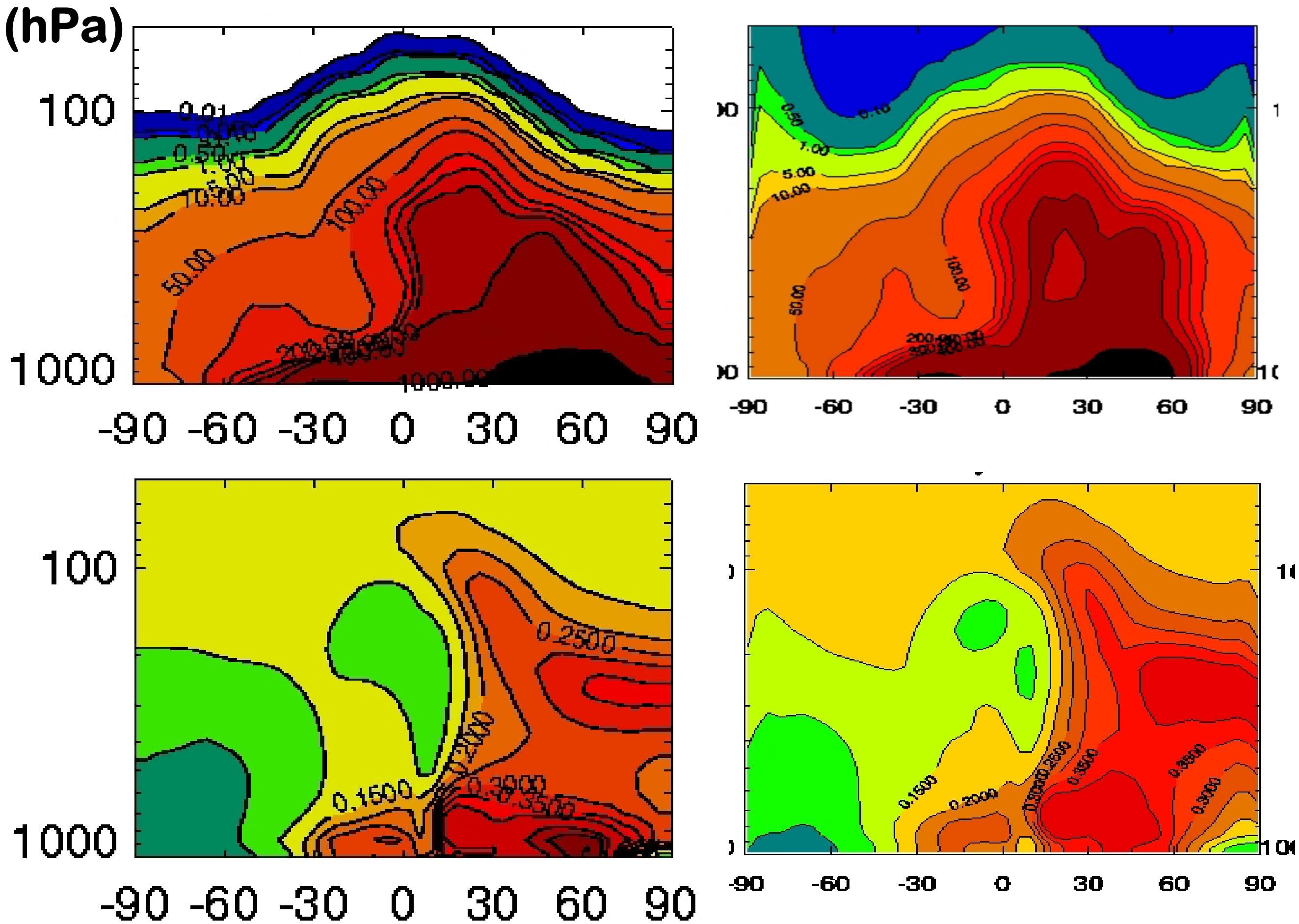
The new algorithm (convec_opt=3) performs better.

GEOS4-DAS ^{222}Rn and ^{210}Pb:
GMI vs GEOS-Chem

GMI, July 2004 | **GEOS-Chem, July 2001**

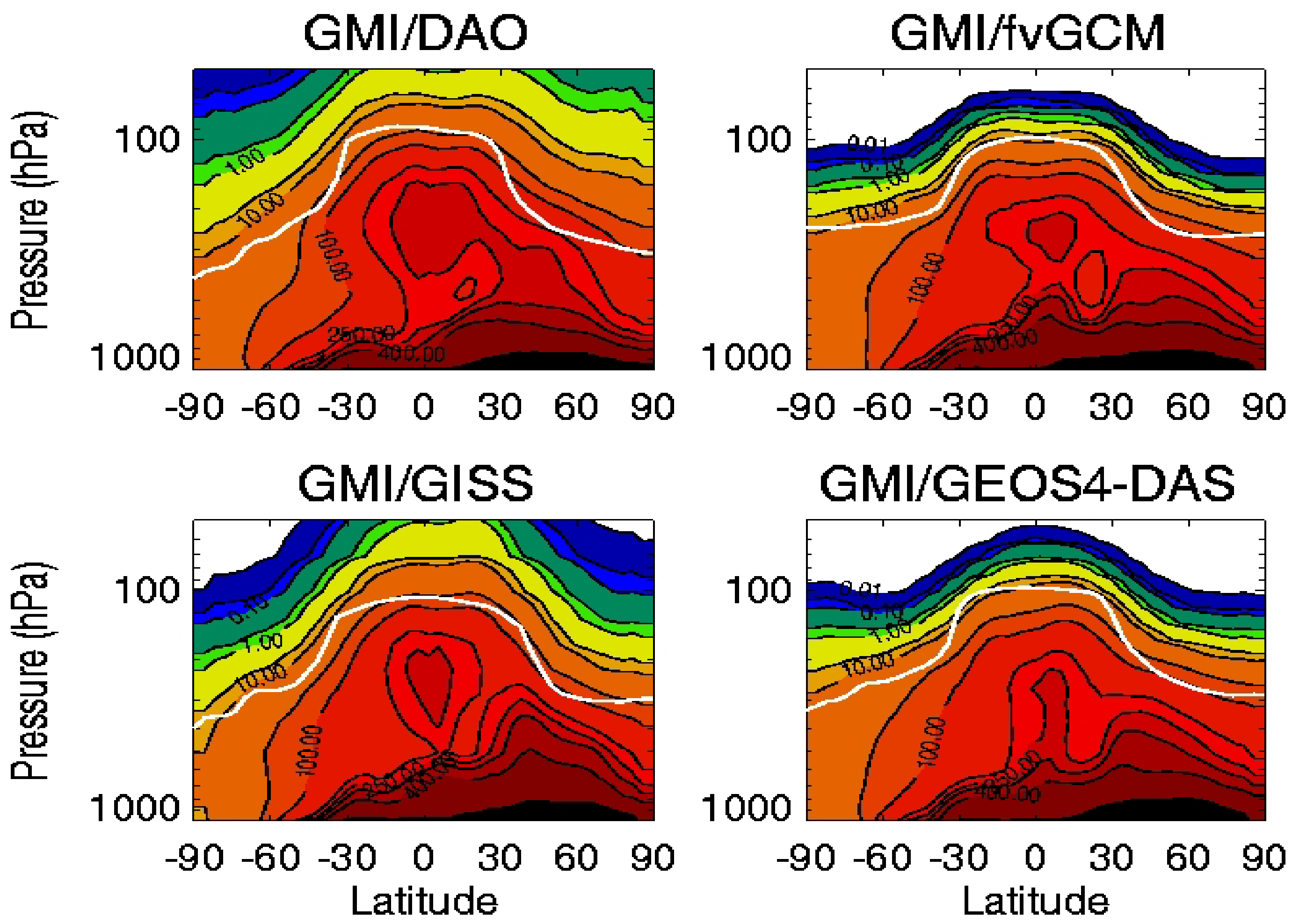
^{222}Rn

^{210}Pb

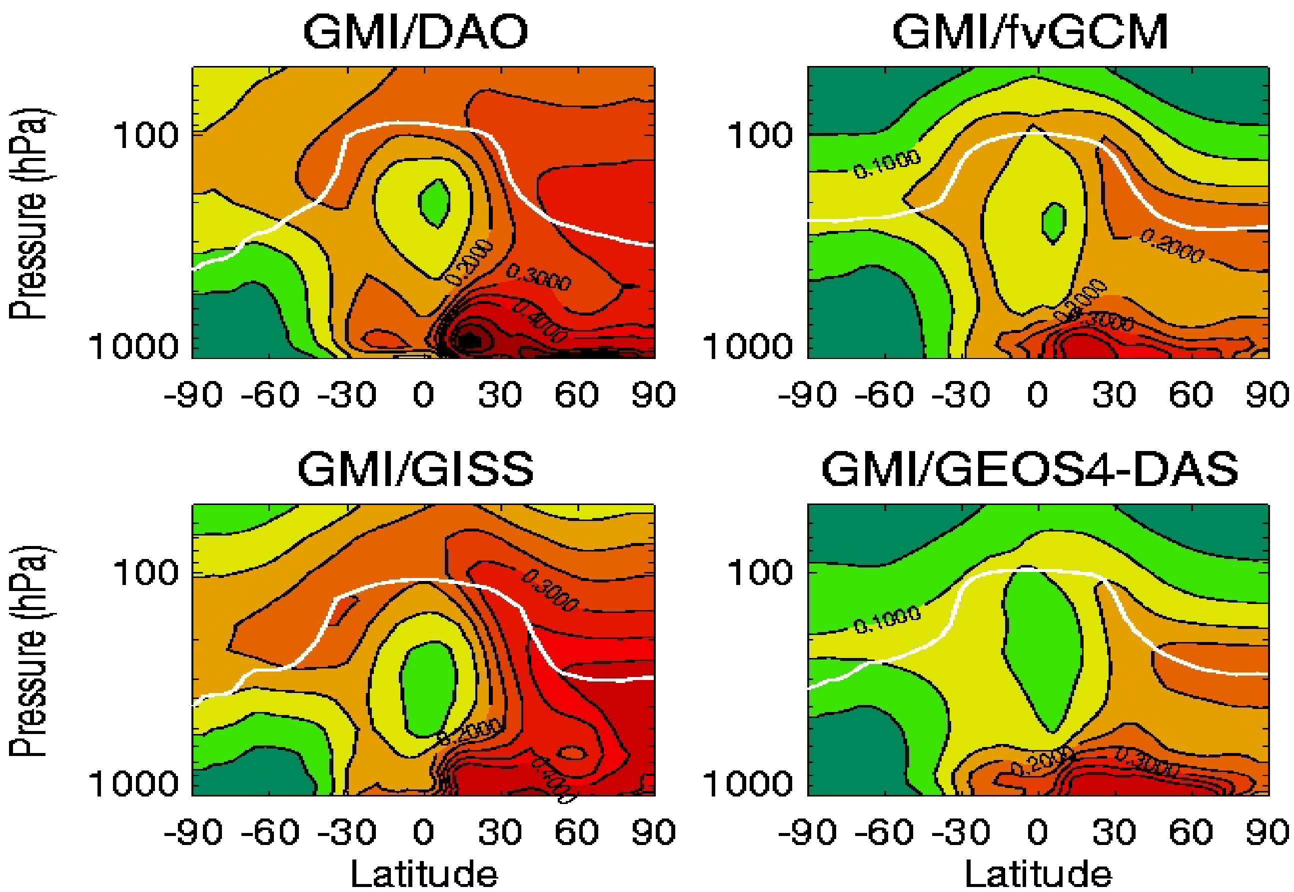


Why more ^{222}Rn in the stratosphere (efficient convective transport) in GEOS-Chem than in GMI?

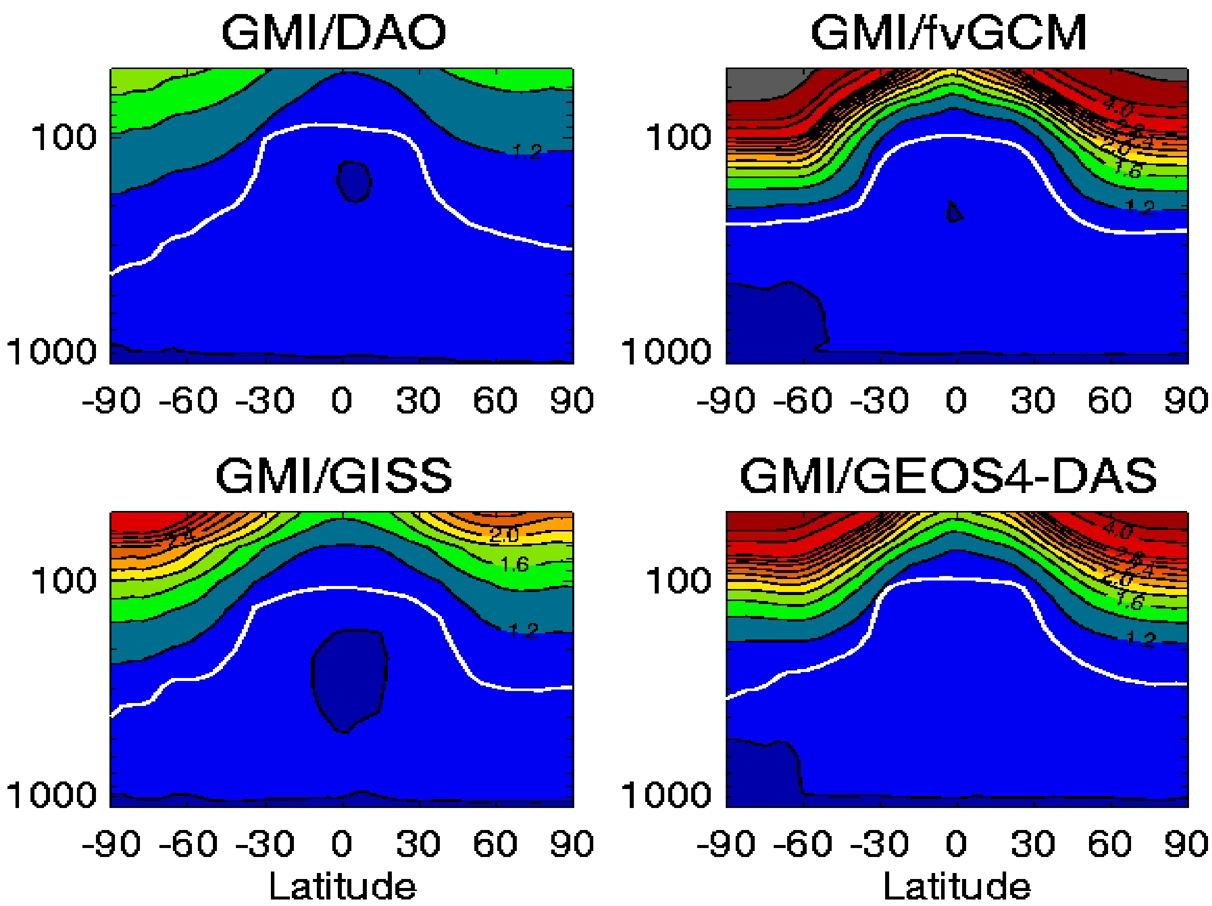
Annual Average ^{222}Rn (mBq/SCM)



Annual average ^{210}Pb (mBq/SCM) with gravitational settling

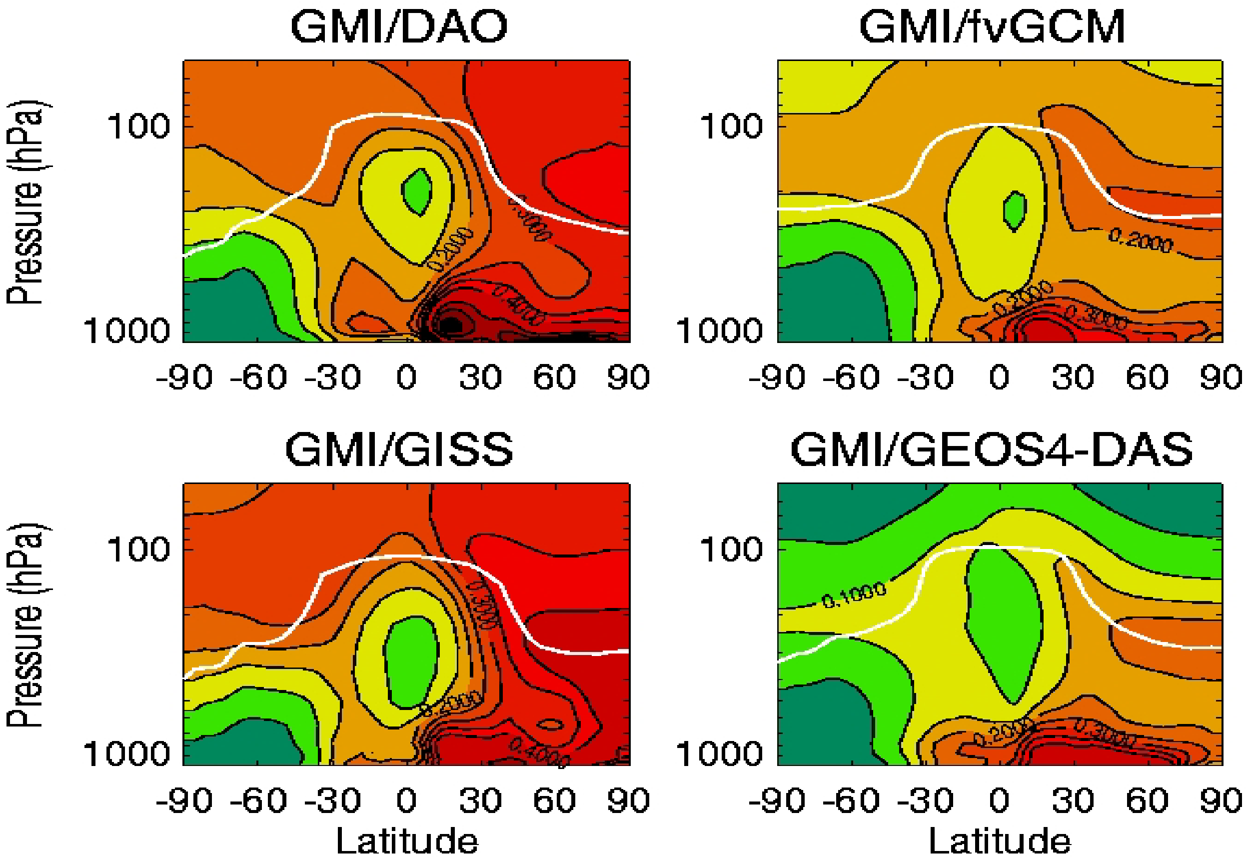


Annual average ^{210}Pb ratios (without/with): Effect of gravitational settling



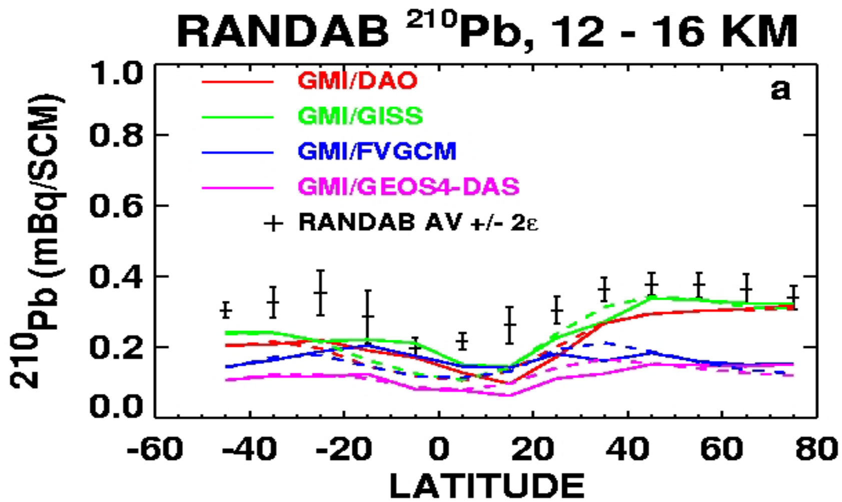
(Effect on ^{7}Be aerosols is not significant.)

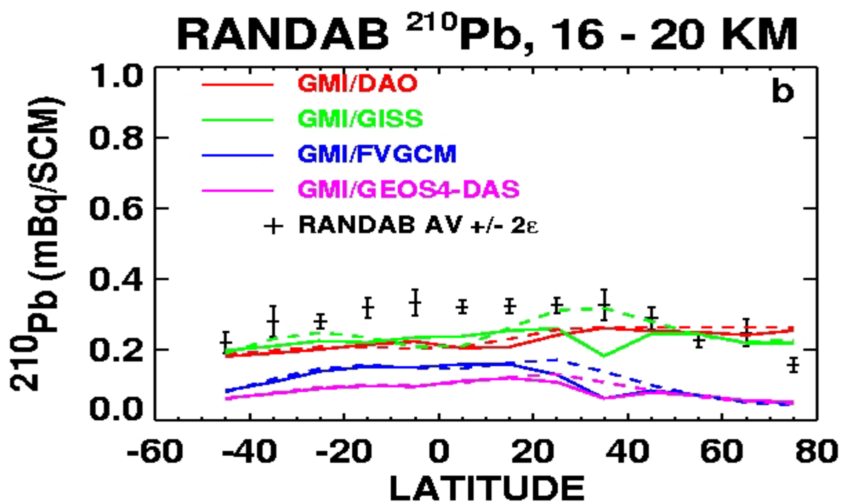
Annual average ^{210}Pb (mBq/SCM) without gravitational settling



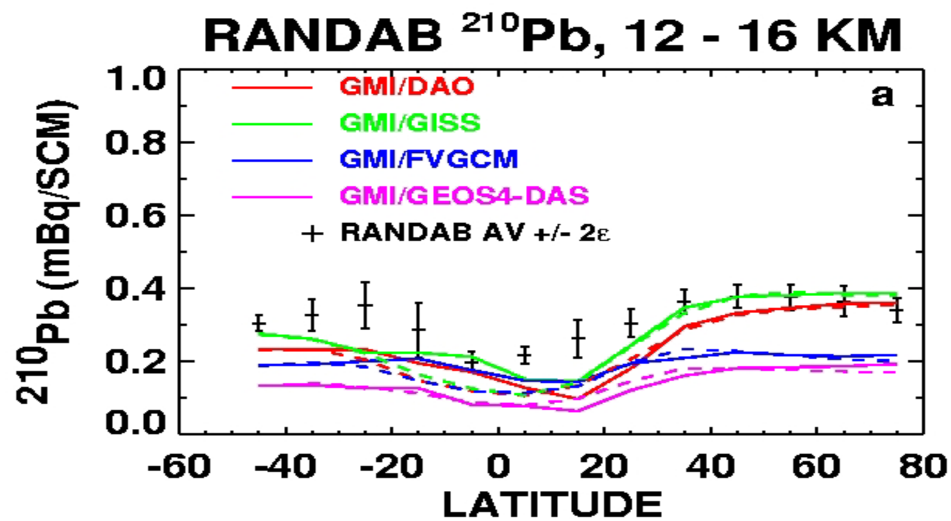
Comparison of observed and GMI ^{210}Pb in UT/LS

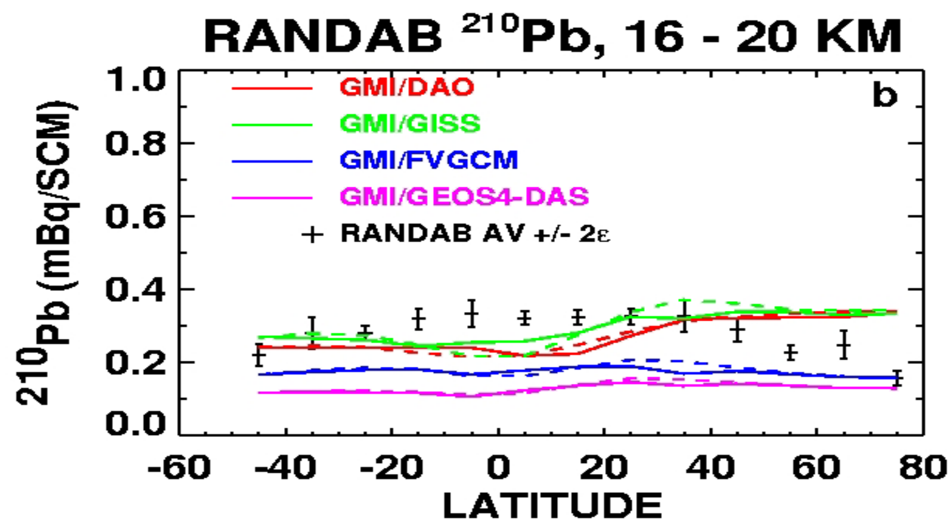
With grav settling



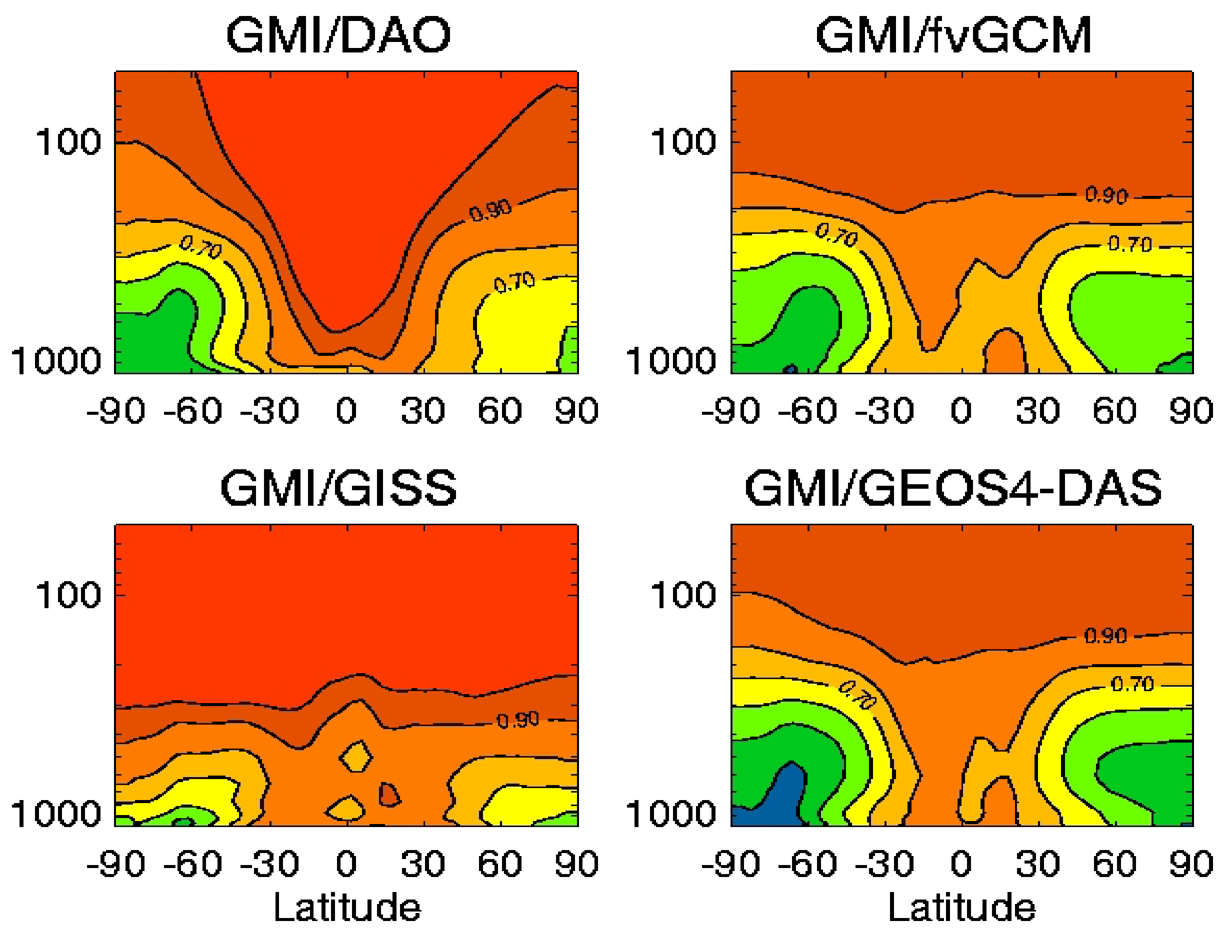


Without grav settling

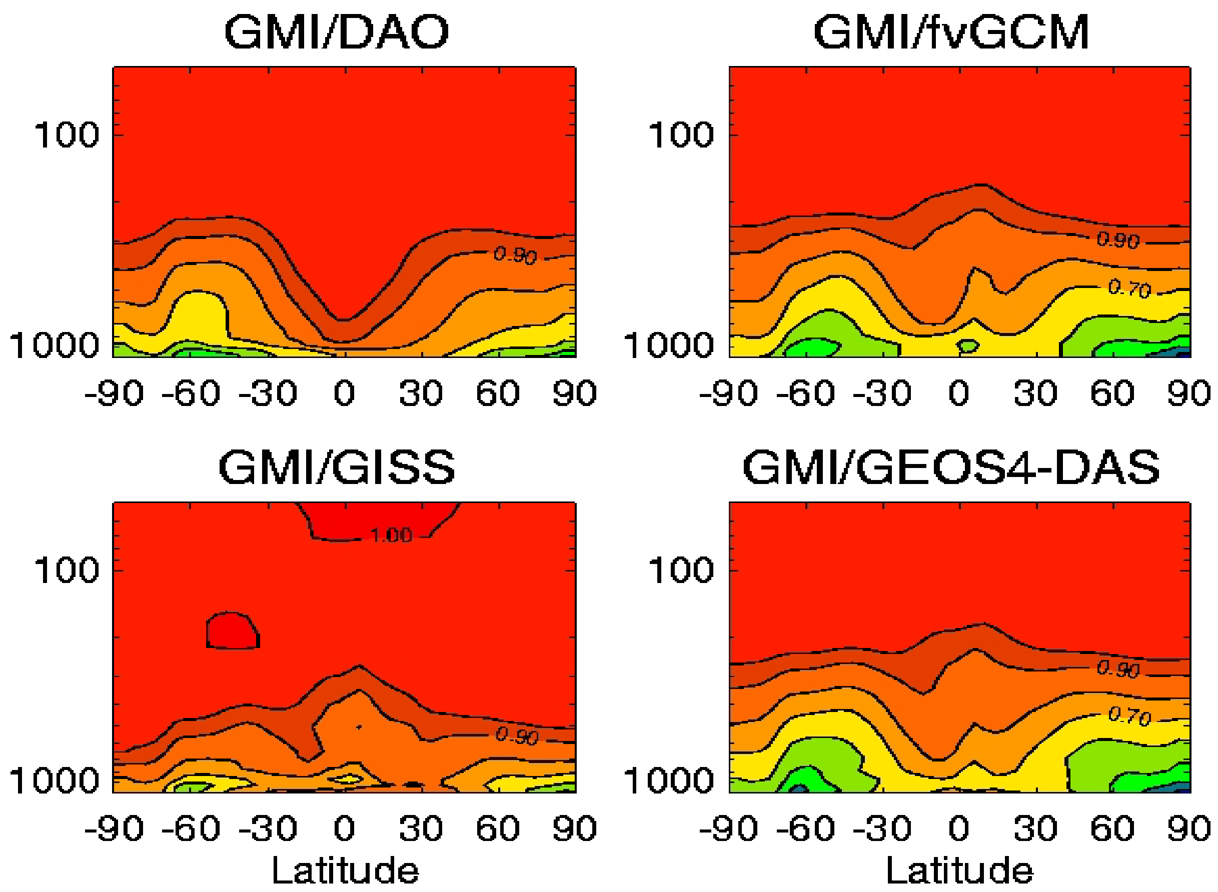




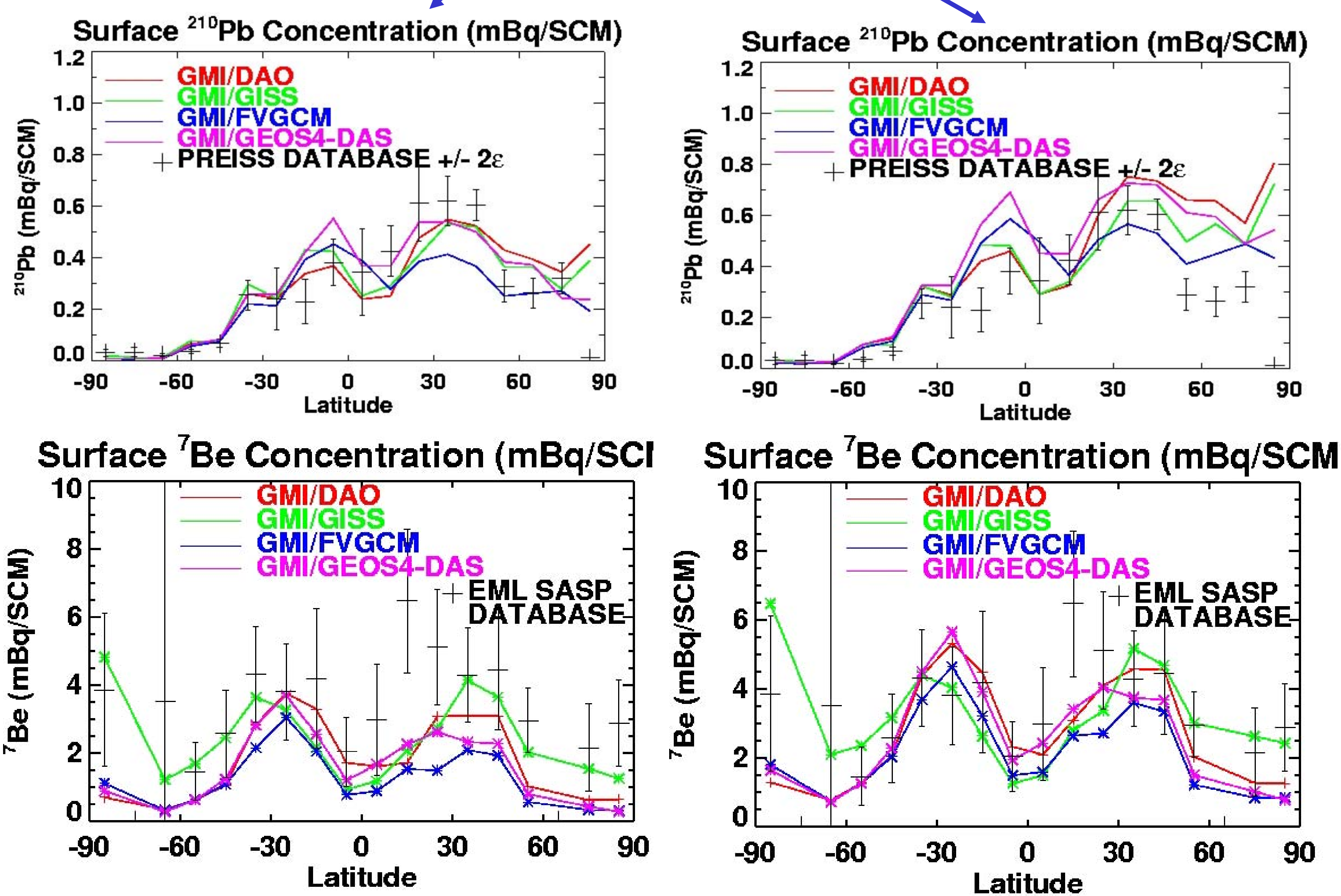
Annual average ^{210}Pb ratios:
(LWC = 0.5×10^{-3}kg/m^3) / (LWC=1.5×10^{-3} kg/m^3)



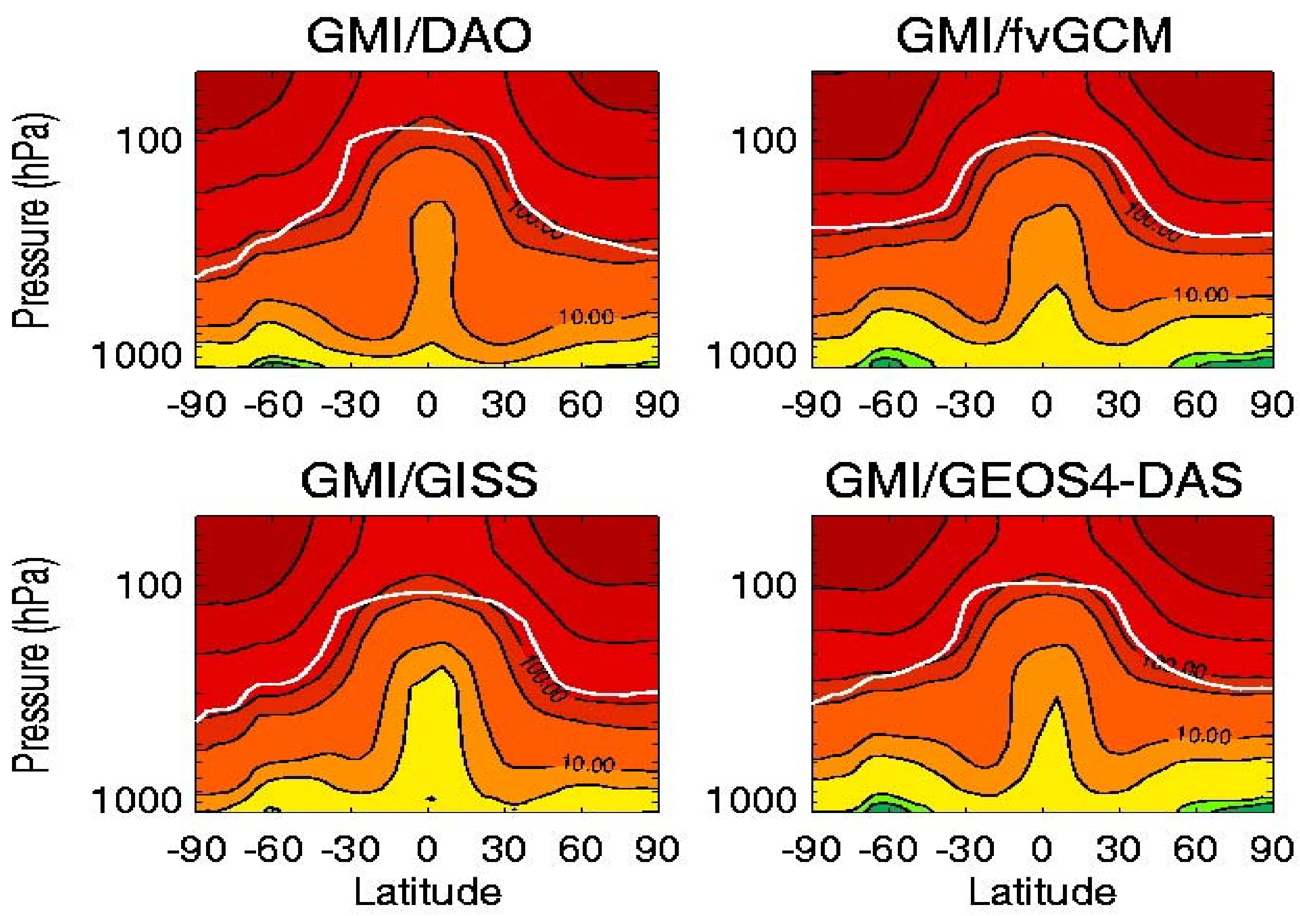
Annual average ^{7}Be ratios:
(LWC = 0.5×10^{-3} kg/m^3) / (LWC=1.5×10^{-3} kg/m^3)



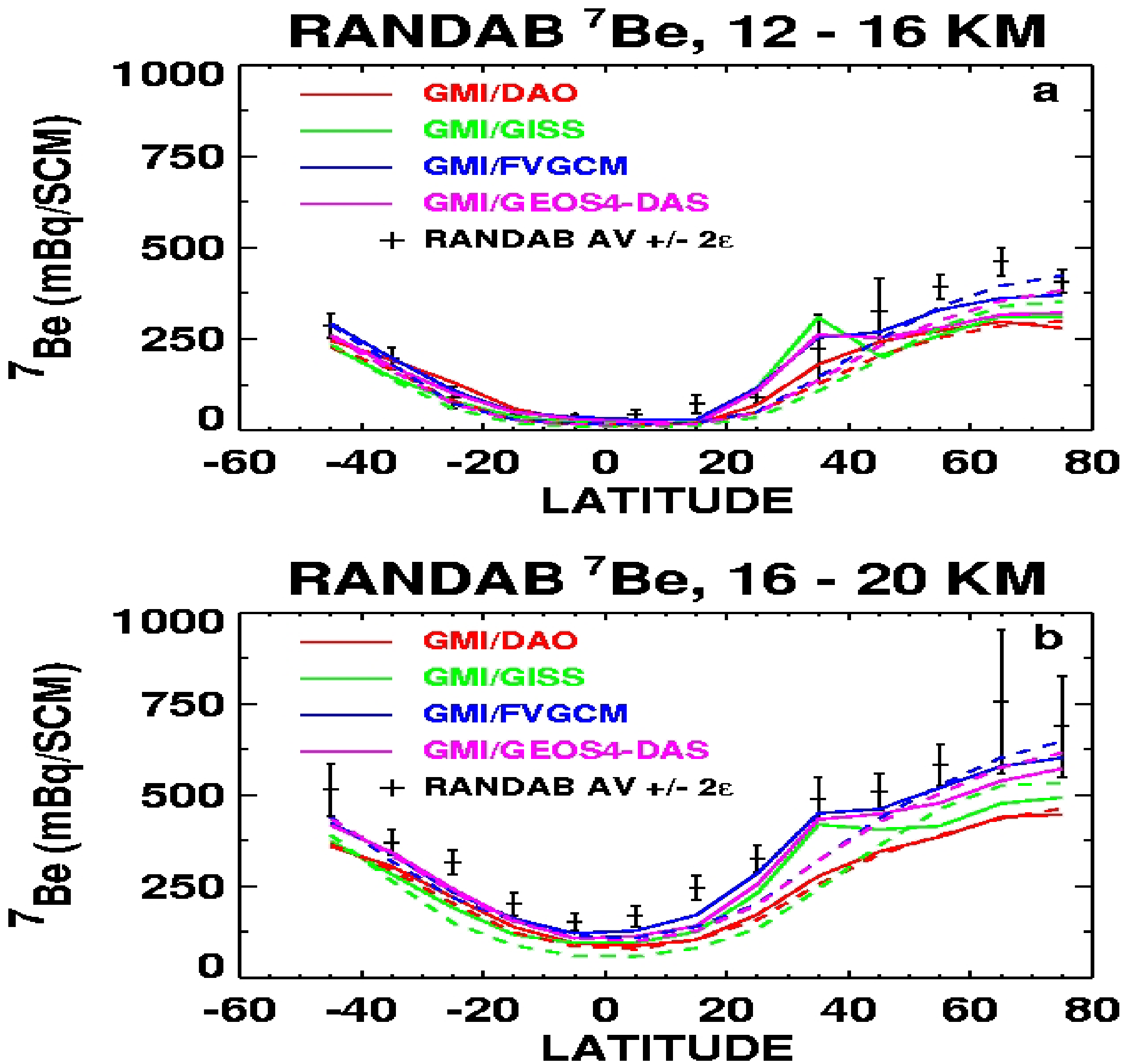
Sensitivity to LWC = 0.5x10^{-3} (GMI) → 1.5x10^{-3} (GEOS-Chem) kg/m^3



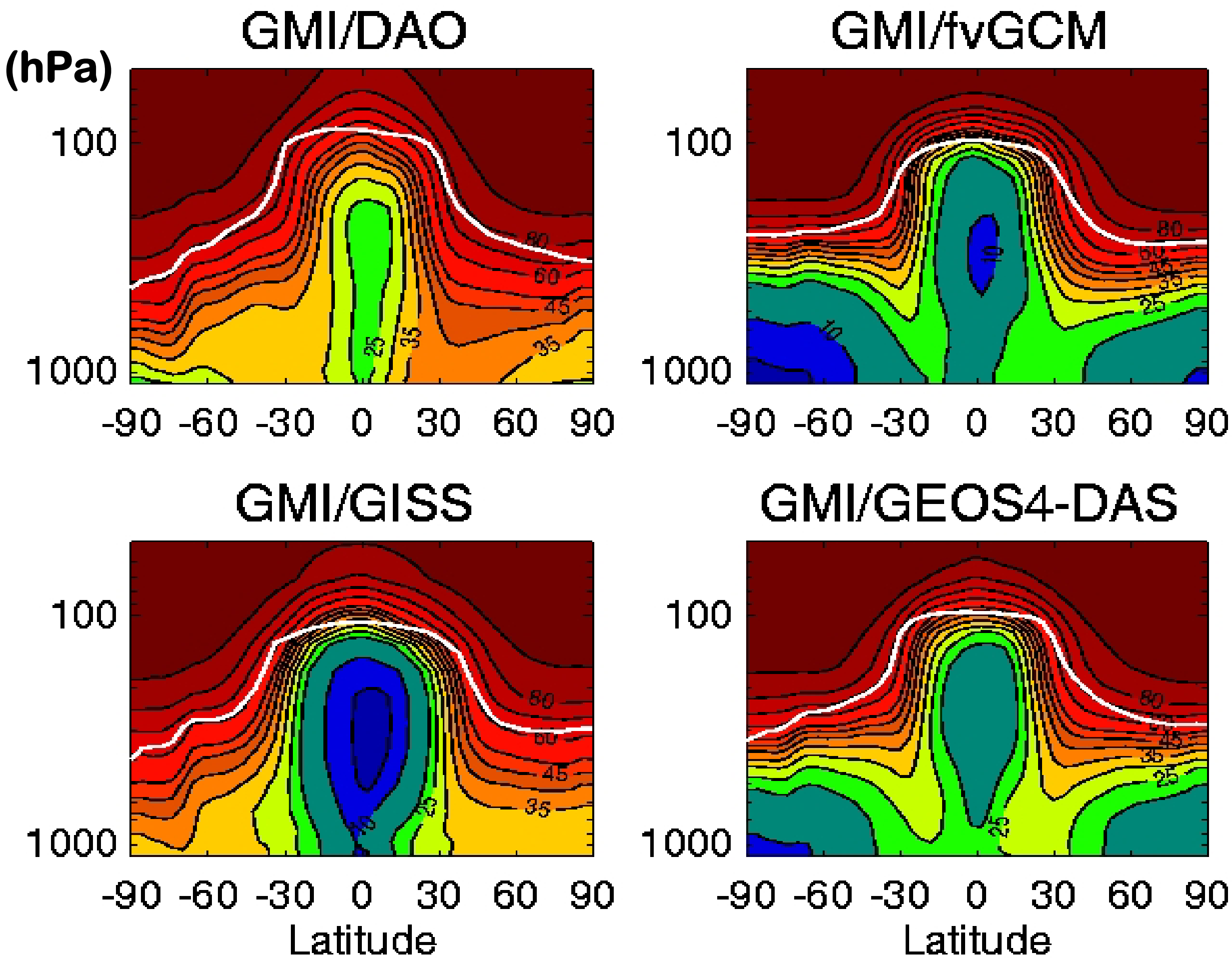
Annual average ^{7}Be (mBq/SCM)



Comparison of observed and GMI ^7Be in UT/LS

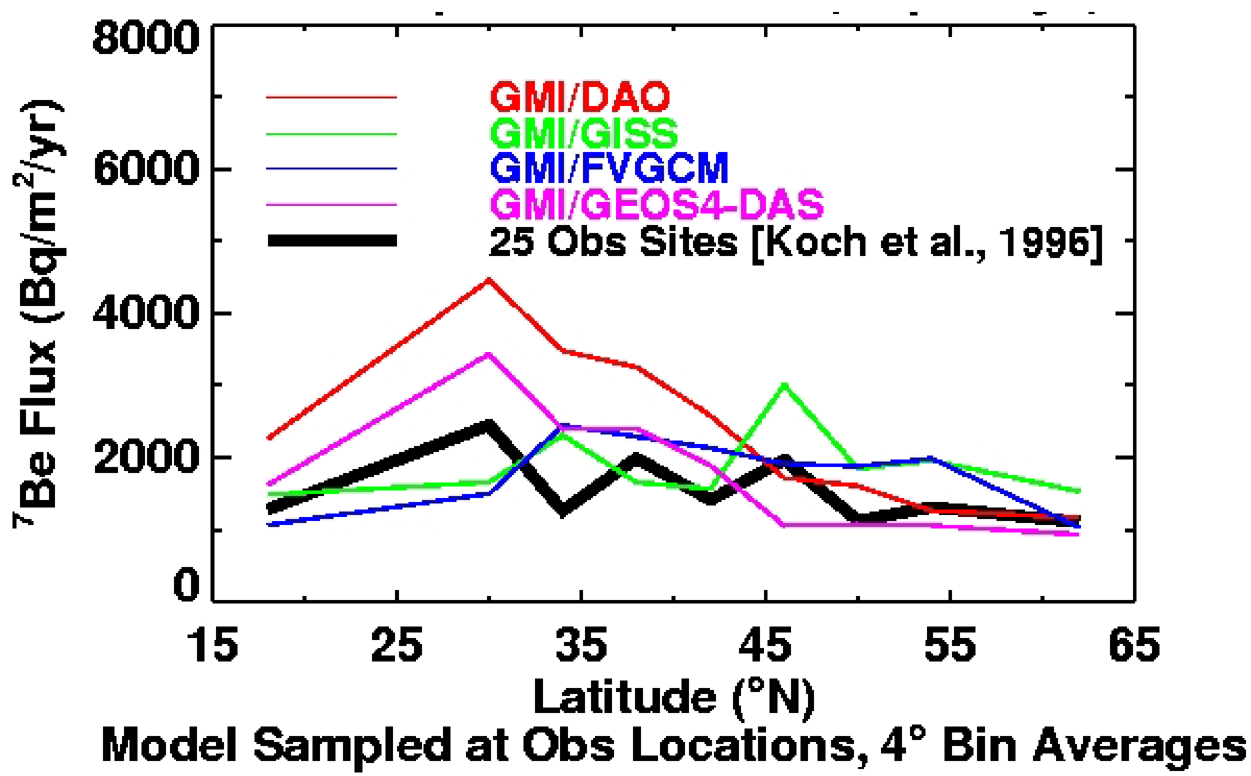


Stratospheric fraction (%) of ^{7}Be, Annual Average



Observed ^{7}Be / ^{90}Sr ratio → 23-27% of ^{7}Be in surface air at NH mid lat is of stratospheric origin

Comparison of observed and GMI ^{7}Be deposition flux



The ^{7}Be deposition flux offers a strong constraint on cross-tropopause transport in global models.

Summary

- ^{222}Rn simulations indicate issues with Land Water Index (LWI) in the GMI GEOS4-DAS met data, and less efficient convective transport in GMI GEOS4-DAS than in GEOS-Chem.

- The ^{210}Pb-^{7}Be pair provides a sensitive test of wet deposition and vertical transport in the model. Using the constraints from ^{210}Pb-^{7}Be requires a revision of existing wet (and other) deposition schemes in GMI.

- Using the GMI modeling framework, we have illustrated that **the ^{7}Be deposition flux offers a strong constraint on cross-tropopause transport in global models.**